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In The Supreme Court of the United States

BORDEN RANCH PARTNERSHIP, ANGELO K. PSAKOPOULOS,

Petitioners,

v.

UNITED STATES ARMY CORPS OF ENGINEERS, *et al.*,

Respondents.

On Writ of Certiorari to the United States Court of Appeals for the Ninth Circuit

BRIEF OF DR. JOY ZEDLER, DR. GENE LIKENS, DR. RONALD JONES, DR. REBECCA SHARITZ, DR. JOSEPH LARSON, DR. BARBARA BEDFORD, DR. JUDITH MEYER, DR. LEIGH FREDRICKSON, DR. ORIE LOUCKS, DR. RAYMOND SEMLITSCH, DR. CHRISTOPHER WOLTEMADE, DR. JOHN CALLAWAY, DR. KLAUS RICHTER, DR. STUART FINDLAY, DR. FREDERICK SHORT AS AMICI CURIAE IN SUPPORT OF RESPONDENT

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STATEMENT OF INTEREST

Pursuant to Supreme Court Rule 37, fifteen scientists file this brief with the consent of the parties as amici curiae in support of Respondent, the United States.[1]

Amici are scientists with broad expertise in America's aquatic ecosystems. They include leading authors on wetlands, hydrology, and aquatic systems, and they have together won many distinguished awards, including the National Medal of Science. Many amici have chaired or served on panels of the National Academy of Sciences established to advise Congress or federal agencies on issues related to wetlands. As discussed below, many amici filed extensive scientific comments in a recent rulemaking related to the issues in this case, which the federal agencies found to present highly relevant and credible evidence. An appendix with a brief biography of each scientist is attached.

SUMMARY OF ARGUMENT

The central question in this case is whether Congress intended to regulate the conversion of wetlands to uplands for use in crop production. According to the District Court, Borden Ranch Partnership accomplished this conversion through the use of mechanized equipment that both drained the swales at issue, and filled them "partially" or "fully." Petitioners equate their activities with normal plowing, and contend that they should not be regulated any more than the normal, ongoing plowing that occurs in many wetlands without draining them. As a matter of science, this argument ignores how drastically deep-ripping differs from normal plowing, principally because it can transform and eliminate wetlands.

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[1] This brief was not authored in whole or in part by counsel for a party, and no person or entity, other than amici curiae or their counsel, made a monetary contribution to the preparation or submission of the brief.

Section 404(f)(2) requires regulation of discharges "incidental" to "*any*" activities that change the use and reduce the reach of waters. The legislative history of this section indicates that Congress intended to regulate the drainage of wetlands for other uses. There is therefore an obvious distinction between the deep ripping and filling of the swales at issue in this case and normal plowing.

Petitioners claim that any change to cropland from a wetland used for rangeland or forestry should not be considered a change in use. However, this interpretation would exempt from the Clean Water Act the majority of the wetland conversion in the United States, including 80% of the wetland conversion that occurred in the twenty years prior to the adoption of Section 404(f).[2] This conversion has been a major source of pollution and of degradation of rivers, wetlands and bays in the United States, including the Everglades, the Gulf of Mexico and the Missouri River.

The fact that the swales at issue in this case were previously grazed does not distinguish these wetlands from nearly 8 million acres of wetlands used as rangelands that retain most or all of their valuable wetland functions. According to USDA, there are also 61 million acres of forested wetlands. Petitioners' interpretation of Sec. 404(f) attempts to define cropping, ranching and silviculture as one use. Under Petitioners' interpretation, Section 404(f) would allow the great majority of the roughly 100 million acres of wetlands in the United States to be converted to uplands for crop use without any regulatory review. It is not possible to reconcile Petitioners' views with Congress's goals to subject the "drainage" of wetlands to review.

Petitioners here excavated soil from five to seven feet below the wetland and mounded it and pushed it into furrows

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[2] Office of Technology Assessment, Wetlands: Their Use and Regulation 87, 92 (1984) (using data from U.S. Fish & Wildlife Service Status and Trends analysis).

two feet high. *Borden Ranch v. U.S. Army Corps of Engineers*, Lexis 21389 at 2 (E.D. Cal. 1999). As the Court of Appeals for the Fourth Circuit recognized in *United States v. Deaton*, the excavation of soils beneath a wetland and their redeposit on the surface "adds" and therefore discharges the statutorily identified pollutant, dredge spoil, which was not present when the material existed only in a more benign form buried under the wetland. 33 U.S.C. Sec. 1362(12). The *Deaton* court recognized that soils, sediments and attached pollutants a few feet below the surface of a wetland or other water body are far less bioavailable and therefore less able to cause harm than those same sediments and pollutants when brought up and spread along the surface. When sediments are deeply buried, it is appropriate to question whether they are part of the water body at all.

The potential harm from these additions of dredge material does not turn on whether the material brought to the surface moves horizontally only a few feet. Neither does a small volume of sediment mean insignificant pollutants have been added since pollutants of concern, such as toxics embedded in the sediment, can cause pollution in microscopic amounts. There is no significant distinction between the soil relocations at issue in this case and those in the many other lower court cases that Petitioners acknowledge involve discharges.

Furthermore, in Section 404(f)(2) Congress required the regulation of discharges that were merely "incidental" to "any" activity that converts wetlands and streams to upland uses. This suggests that Congress wished to reach broadly to cover essentially any movements of sediment associated with the conversion of wetlands. That counsels against Petitioners' efforts to dismiss as too small the soil relocations at issue in this case. They were sufficient to fill and convert the wetland and therefore were the exact type of activity Congress sought to regulate through Section 404(f)(2).

ARGUMENT

I. Congress's intent to regulate the conversion of wetlands to uplands would have little significance if conversions to cropland were not included.

A. *Statutory Background*

A brief summary of the language and legislative history of Section 404(f) is necessary to appreciate the relevance of the scientific information presented here.

Section 404(f)(2), 33 U.S.C. Sec. 1344(f)(2), requires a permit for discharges "incidental" to "any activity" that are designed to "change" the "use" and "reduce the reach" of regulated waters. Since wetlands can be waters of the United States, this language on its face applies to activities that change the use and "reduce the reach" of wetlands by filling or draining them and thereby eliminating them or reducing their extent as waters of the United States. This concern about the drainage of wetlands is also reflected by Section 404(f)(1), which exempts only "minor" drainage, not major drainage. The desire to regulate drainage is also implied by Section 404(f)(1)(c), which exempts both the "construction" and "maintenance' of irrigation ditches, but exempts only the "maintenance" not the new construction of "drainage ditches" that effects new drainage.

The legislative history of Section 404(f) articulates this intent to regulate fill and dredging activities that convert wetlands to uplands through drainage. The report of the Senate Committee, which crafted 404(f), stated: "The exemption for minor drainage does not apply to the drainage of swampland or other wetlands." S. Rep. 95-370, 76, *reprinted in* 1977 U.S.C.C.A.N. 4326, 4401 (emphasis supplied). In discussing Section 404(f)(2), the report also stated, "[P]ermit review is necessary for placement of fill to

convert a hardwood swamp to another use through construction of dikes or drainage channels." *Id.* at 4402. On the floor, Senator Muskie, the principal author of the amendments, explained, "Permits are required . . . where ditches or channels are dredged in a swamp, marsh, bog, or other truly aquatic area." See 123 Cong. Rec. S26767 (daily ed. Aug. 4, 1977).[3] Indeed, the requirement to regulate conversion was part of an overall goal to exempt only those activities that would have "'little or no adverse affect'" on the nation's waters. *Avoyelles Sportsmens League, Inc. v. Marsh*, 715 F.2d 897, 926 (5th Cir. 1983) (quoting floor statement of Senator Muskie).

The District Court found that the activities by Borden Ranch converted wetlands used for grazing into uplands for the purpose of planting a vineyard both by filling and draining them. E.R. 1011-12.[4] Petitioners argue, however, that converting grazing land to cropland is not a change in use and so is not subject to Section 404(f)(2). Petitioners argue, in fact, that "normal farming, silviculture and ranching" should all be treated as the same use because they are all listed in Section 404(f)(1) (even though Congress considered them to be different enough to list them separately.) This interpretation would allow conversion of both grazed and timbered wetlands to uplands used for crops

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[3] Even those who favored broader legal changes agreed that at least large-scale drainage of wetlands should be regulated. Senator Dole stated: "I agree that the construction of major canals and waterways designed to modify significantly or to drain an entire swamp or marshland should not fall within the category of 'minor drainage.'" 123 Cong. Rec. S26767 (daily ed. Aug. 4, 1977).

[4] Petitioners repeatedly assert that the land was capable of being "farmed" even before this conversion. The legal significance of this capability is not clear, but in any event, the District Court specifically found that Petitioners deliberately deep-ripped the land to drain it for the purpose of being able to plant vineyards and orchards that could not otherwise be planted on the land because it was too wet. ER-1011-12.

without regulatory review. Science relevant to these discussions is presented below.

B. Significance of conversion of grazed or forested wetlands to cropland

By the 1980's, the contiguous Unitted States had lost more than half of the estimated 221 million acres of wetlands that existed in the 1780's and had only slightly more than 100 million acres left.[5] The "vast majjority" of this loss resulted from conversion to croplands. *Ild.* at 9. In the two decades preceding Congress's enactment of Section 404(f) in 1977, rates of loss were averaging 550,000 acres per year, and eighty percent of this loss resulted from conversion to croplands.[6] Moreover, much of this conversion was concentrated in the southeast, where bottomland hardwood swamps (the wetlands specifically identified in the Senate report for Section 404(f)) were being rapidly converted to soybean fields as described in *Avoyelles*.[7]

Petitioners contend that there is no change in use because the wetland swales at issue were already grazed. But grassed wetlands have been used extensively for grazing by farmers since at least the Middle Ages. Fred P. Bosselman, *Limitations Inherent in the Title to Wetlands at Common Law*, 15 Stanford Envt'l L.J. 247, 279 (1996) (discussing common use of grazing lands in English wetlands).

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5 T.E. Dahl, Wetland Losses in the United States, 1780's to 1980's. (U.S. Department of the Interior 1990).

6 OTA, *supra* note 2, at 87, 92; W.E. Frayer, T.J. Monahan, D.C. Bowden, & F.A. Graybill, Status and Trends of Wetlands and Deepwater Habitats in the Conterminous United States, 1950's to 1790's (1983).

7 See OTA, *supra* note 2, at 108; Dahl, *suprra* note 5, at 9 (mapping conversion of wetlands to cropland). To understand that the wetland conversion at issue in Avoyelles was for the creation of a soybean field, see the District Court opinion at 511 F. Supp. 2783, 287 (W.D. La. 1981).

Throughout the United States, in fact, both wetland and upland grasslands were grazed naturally by bison, deer and other ungulates, and therefore are compatible with at least some grazing. (See discussion infra at 15-16). USDA estimates that these kinds of rangelands occupy 578 million acres, roughly 30% of the contiguous United States,[8] and wetlands used as rangeland occupy an estimated 7.8 million acres.[9] Under Petitioners' theory, all these wetlands could be converted to uplands for cropping purposes without any regulatory review.

Moreover, more than half of the remaining wetlands in the United States are forested (roughly 61 million acres according to USDA),[10] and nearly all of these wetlands have been subject to periodic silvicultural use through at least timber harvest.[11] Wetlands subject to extensive forestry

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8 Economic Research Service, Agricultural Resources and Environmental Indicators 1:1-3 (2000).

9 Ralph E. Heimlich, Keith D. Wiebe, Roger Claassen, Dwight Gadsby, Robert M. House, Wetlands and Agriculture: Private Interests and Public Benefits 22 (USDA, Economic Research Service 1998).

10 Heimlich, et al., *supra* note 9, at 22. (Sometimes figures of roughly 50 million acres are used by the Fish & Wildlife Service, separating forested wetlands from shrub wetlands.)

11 The fact that forested wetlands have been harvested for timber is simply a reflection of the fact that nearly all the country's forests have been periodically subject to timber harvest and other silvicultural activities. See David Wilcove, The Condor's Shadow: The Loss and Recovery of Wildlife in America 18 (1999) ("So thorough were the settlers and timber companies that, over the course of about two centuries, almost every acre of virgin forest from Maine south to Florida and west to the Great Plains fell to the ax or saw."). *See also* Reed Noss, Edward T. Laroe III, J. Michael Scott, Endangered Ecosystems of the United States: A Preliminary Assessment of Loss and Degradation, National Biological Survey Biological Report 28, 37 (1995) (95-98% loss of virgin forests in contiguous U.S. by 1990); Reed F. Noss & Robert L. Peters, A Status Report on America's Vanishing Habitat and Wildlife 68 (1995) (southern forested wetlands have been "extensively logged");

include the category of "bottomland hardwood swamps" identified in the Senate Report as lands whose conversion to other uses would be regulated. These wetlands too, under Petitioners' theory, would be subject to conversion to uplands for cropping purposes without any regulatory review.

The potential for conversion under Petitioners' theory is not merely theoretical. In 1998, the Economic Research Service of the U.S. Department of Agriculture estimated that if legal restrictions were dissolved, farmers would likely convert another 5.8 to 13.2 million acres of wetlands purely for farming purposes. Interestingly, ERS also estimated that overall farm income would decline since the increased production would depress farm prices.[12]

Of course, once wetlands are converted to upland crops, the lands are no longer waters of the United States under the Clean Water Act. They can then be converted to roads, buildings or other developed uses without a permit. If Petitioners' theory were accepted, therefore, wetlands would likely be extensively converted to upland crops as a temporary step toward developing them.

For Petitioners' interpretation of Section 404(f) to be correct, Congress in 1977 must have wished to ignore the vast majority of conversions from wetlands to uplands occurring at the time and throughout American history. And if Petitioners' interpretation were correct, even conversion of wetlands to developed uses could easily circumvent any regulatory review. Petitioners' interpretation of 404(f) is inconsistent with Congress's intent to regulate wetland conversion.

Mitsch & Gosselink, *supra*, at 56 (Great Dismal Swamp in Virginia and North Carolina subject to extensive forestry).

[12] Heimlich et al, *supra* note 9, at 31-38.

C. *Environmental affects of wetland conversion to cropland*

The significance of wetlands to the chemical, physical and biological integrity of the nation's water bodies is difficult to overestimate. They filter pollutants that could otherwise clog, poison or over-fertilize deeper portions of rivers and bays. They transform these pollutants into plant materials and small animals that form the base of much of the aquatic food chain. They provide the spawning or rearing grounds for large numbers of fish species, and the principal foraging grounds for the waterfowl, wading birds and raptors that rely on aquatic ecosystems.[13]

Drainage of wetlands for cropping purposes eliminates or degrades all wetland functions. Numerous studies have documented the increase in water pollution that occurs in streams in agricultural areas when wetlands are drained and converted to cropland.[14] As these studies reveal, this kind of

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[13] See generally, Office of Technology Assessment, Wetlands: Their Use and Regulation 43-61 (1984) (summarizing wetland functions). See also discussion and citations below.

[14] See generally, Christopher Woltemade, *Ability of Restored Wetlands to Reduce Nitrogen and Phosphorus Concentrations in Agricultural Drainage Water*, J. Soil & Water Cons. 303-309, 303 (2000) (citing numerous studies showing elevated concentrations of pollutants in agricultural drainage water). For example, in one study comparing two similar streams, one of which had been straightened into a drainage ditch and experienced great wetland drainage, the other of which retained its wetlands, the U.S. Geological Survey documented downstream sediments loads 32 times greater and nitrogen loads 23 times greater in the channelized system, and also documented more rapid flood flows and stream erosion. H. Cochrane & S.D. Williams, *Nutrient & Sediment Loads in a Channelized Stream and a Nonchannelized Wetland Stream in the Beaver Creek Watershed, West Tennessee, in* Instream Investigations in the Beaver Creek Watershed in West Tennessee 1991 through 1995, USGS Water Resources Investigations Report 96-4186 (1996). See also R.K. Neely & J.L. Baker, J.R. Jones, V.P. Borofka & R.W. Bachman, *Factors Affecting Nutrient Loads in Some Iowa Streams*, 10 Water Res.

drainage also increases soil erosion along the stream banks, bringing a new source of sediment downstream. See generally 40 C.F.R. Sec. 230.41.

In describing her home ranch, Justice O'Connor colorfully depicts the erosive effect of channelizing flow on agricultural landscapes.

> "In an effort to keep floodwater away from the railroad tracks, the railroad company built levees and diversions to channel the water [of Railroad Draw] out from the rail bed. In time these efforts led to massive erosion, cutting a channel in the draw as deep as fourteen feet in places. Where formerly the rainwater had spread out over wide areas of the draw and produced thick grass in the rainy seasons, after the levee and diversion work, gullies formed, which in turn developed into steep defined canyons."

Sandra Day O'Connor and H. Alan Day, Lazy B: Growing Up on a Cattle Ranch in the American Southwest 260 (2002). Although this channelization was not undertaken for agricultural purposes, and the passage does not clearly defines the characteristics of "Railroad Draw," the results precisely reflect the consequences that often occur when wetlands are drained to produce crops.

The ecological significance of this conversion can be illustrated by a few examples.

Of the historic Everglades, roughly the northern quarter have been drained through a complicated system of ditches and pumps to form the Everglades Agricultural Area, predominantly used for sugarcane. Ongoing drainage of this

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117-121, 120-21 (1976) (watersheds with fewer wetlands and more drainage have increased nutrient loads in streams).

cropland dramatically alters the flow of water into the Everglades, pouring in too much water during rainy seasons and wet years and too little water during dry seasons and dry years. These changes have greatly contributed to major ecological declines, including pollution that has transformed major chunks of the historic "river of grass" to dense stands of cattail, major declines in fish populations and the loss of 90% of the historic populations of wading birds. Reversing the hydrologic effects is a major focus of the $7.8 billion Everglades restoration plan authorized by Congress in 2000.[15]

The corn belt states of Ohio, Indiana, Illinois, Iowa and Missouri have lost at least 85% of their wetlands (25 million acres total), almost all to agricultural conversion.[16] Similarly, the lower Mississippi Valley has lost three quarters of its 21 million acres of forested wetlands, primarily to cropland conversion.[17] This drainage of wetlands for cropland has allowed excess "nutrients" to flow to the Gulf of Mexico creating a large "dead zone." Nitrogen fertilizer running off cropland is no longer filtered by wetlands, and the nitrogen creates explosions of algae. When they die, the bacteria that eat them suck the oxygen out of the water that is

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15 Good explanations of this Everglades problem can be found in South Florida Water Management District, Everglades Interim Report (1998) (a peer reviewed publication that describes both the major water quality problems and hydrologic changes that have affected the Everglades); U.S. Army Corps of Engineers, Central and Southern Florida Project Comprehensive Review Study, Final Integrated Feasibility Report and Programmatic Environmental Impact Statement (April 1999). For discussions of the declines in fish and wading bird populations see pages 3-1, 3-2, 3-9 and 3-11.

16 See Dahl, *supra* note 5, at 6, 9 (listing losses by state and mapping extent of drainage for agriculture).

17 William. J. Mitsch & James G. Gosselink, Wetlands 49 (1993). Heimlich et al, *supra* note 9, at 20 (attributing losses primarily to cropland conversion).

needed for fin and shellfish, leaving an area the size of Massachusetts devoid of aquatic life.[18] In order to make up for the historic loss of wetlands, scientists working for the federal government to design a solution have identified the need to restore millions of acres of wetlands.[19]

Levee and drainage activities along the lower Missouri River have contributed to the extensive loss of wetlands, and other shallow habitats such as oxbow lakes and mudflats, as the habitats were converted to cropland. These wetlands and related habitats originally provided critical spawning and rearing grounds for the river's fish, and they produced much of the insects and plant material that supported the river's food web. In part to protect this new cropland that would otherwise flood each year, dams on the upper river are managed to control the natural rise and fall of the river. According to a recent report of the National Academy of Sciences, "Of the 67 native river fish living along the mainstem [of the river], 51 are now listed as rare, uncommon, and/or declining . . . ."[20]

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18 See generally, U.S. National Science and Technology Council, Committee on Environment and National Resources, Integrated Assessment, Hypoxia in the Northern Gulf of Mexico (2000).

19 See William Mitsch, John Day, Jr., Wendell Gilliam, Peter M. Groffman, Donald E. Hey, Gyles W. Randall & Naiming Wang, *Reducing Nitrogen Loading to the Gulf of Mexico from the Mississippi River Basin: Strategies to Counter a Persistent Ecological Problem*, 51 Bioscience 373-88 (2001). "Because of extensive artificial drainage over the past 200 years, many of the once-ubiquitous freshwater wetlands and riparian zones associated with the streams and rivers of the basin no longer exist. Gone with them is their capacity to mitigate water pollution." *Id.* at 376.

20 National Research Council of the National Academy of Science, The Missouri River Ecosystem: Exploring the Prospects for Recovery 3 (2002). In addition to the National Research Council report, for a good summary of the changes to the Missouri River and its impacts, see D.L. Galat, J.W. Robinson, and L.W. Hesse, *Restoring Aquatic Resources to the Lower Missouri River: Issues and Initiatives*, in Overview of the

The uncontrolled conversion of wetlands to uplands used for crops is inconsistent with Congress's intent to exempt only activities with "little or no adverse effects" on the nation's waters, *Avoyelles*, 715 F.2d at 926.

D. Cropping and grazing have different environment affects and are treated as different uses by federal agricultural policies.

Cropping and grazing should be treated as different uses, among other reasons, because they have dramatically different environmental and economic consequences and as a result have been treated differently by the U.S. Department of Agriculture and federal agricultural policy. For example, USDA conducts a private land census on a periodic basis, and in doing so, distinguishes five major land uses: cropland, grassland pasture and range, forestland, urban uses, special uses and miscellaneous. Within the contiguous United States, grassland pasture and range is the largest use at 589 million acres and exceeds cropland at 460 million acres and forestland at 559 million acres.[21]

River-Floodplain Ecology in the Upper Mississippi River Basin (D.L. Galat & A.G. Frzer eds.) (1994); U.S. Fish & Wildlife Service, Missouri River Biological Opinion 116 (2000) (describing habitat losses and their significance). Another good summary of the Missouri River changes stated as follows: "The Missouri River's natural riparian ecosystem has been nearly eliminated and presently consists of a discontinuous, single row of trees. Missouri River floodplain forest coverage decreased from 76 percent in 1826 to 13 percent in 1972, while cultivated lands increased from 18 percent to 83 per cent. . . . Population densities of fish species of chubs, and two species of minnows have been reduced by as much as 95 percent since 1971." Interagency Foodplain Management Review Committee, Sharing the Challenge: Floodplain Management Into the 21st Century 56-57 (1994).

21 Economic Research Service, Agricultural Resources and Environmental Indicators 1:1-3 (2000), page 1:1. See also National Resources Conservation Service, Summary Report, 1997 National

Reflecting the different environmental effects of ranching and cropping, agricultural conservation programs seek to limit the conversion of rangeland to crops but do not restrict grazing. For example, both the Sodbuster and Swampbuster provisions of the Food Security Act of 1985 deny certain farm subsidies to farmers who convert potentially erodible grasslands or wetlands to cropland, but there are no consequences for grazing such lands.[22] The Conservation Reserve Program pays farmers to reconvert cropland to grasslands or forests to control soil erosion, and improve water quality and wildlife habitat, but the law allows controlled grazing of such lands. 16 U.S.C. Sec. 1232(1)(7), as amended by Section 2101 of the Farm Security and Rural Investment Act of 2002, P.L. 107-171, 161 Stat. 134 (2002). And a new Grassland Reserve Program pays farmers not to convert grasslands to croplands, but allows grazing to continue. Section 2401, P.L. 107-171 (2002).

These policies reflect Congressional awareness of the environmental consequences of converting grazed lands, including grazed wetlands, to croplands. The policies reflect the significant environmental distinctions between growing crops and ranching.

First, a wetland grazed under natural conditions maintains its basic water quality and flow-slowing

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Resources Inventory 18-24 (Revised 2001) (separating cropland from range and pasture land).

22 16 U.S.C. Sec. 3801(a)(1)A) (defining agricultural commodity, the production of which can lead to the loss of crop benefits, only as an "agricultural commodity planted and produced in a State by annual tilling of the soil").

functions.[23] Water quality filtration, for example, occurs through the contact between water and the plants and the wetland soil.[24] The conversion to an upland crop will greatly reduce or eliminate functions like water quality filtration, particularly of long swales that provide a long distance for water to interact with the soils.

Second, cropping typically involves the regular turnover of soil, leaving it exposed to water and wind erosion.[25] Soil erosion on cropland is one of the largest water quality problems in the United States. [26] There can be some erosion on rangeland, but it is typically minimal by comparison because the grasses and their roots hold the soil in place. The

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23 Paul R. Adamus, A Process for Regional Assessment of Wetland Risk, ch. 4.5 (1992) (reviewing literature regarding impacts of grazing on northern prairie wetland functions and finding no effects on runoff volume, timing and groundwater recharge, only limited effect on capacity to retain sediment and phosphorus and possibly enhanced breakdown of nitrogen).

24 See Mitsch & Gosselink, *supra* note 17, at 139-58 (discussing transformation of pollutants in wetland soils).

25 It is poss le to plant some crops without complete annual tillage, but such no-till cropping was used by only 15% of cropland in the U.S. in 1997, and 63% of farmers have yet to adopt any form of conservation tillage, which includes leaving residue on the crop fields to limit erosion. Merritt Padgitt, Doris Newton, Renata Penn, Carmen Sandretto, Production Practices for Major Crops in U.S. Agriculture, 1990-97, 67 (Economic Research Service 2000).

26 Natural Resources Conservation Service, A Geography of Hope 40 (1996) (hereinafter "Geography of Hope") ("One of the major sources of water quality impairment from agriculture is the sediment . . . that enters streams as a result of soil erosion.") A national map of estimated sediment delivered to rivers and streams from soil erosion shows heavy delivery in intensively cropped regions and little delivery from areas dominated by rangeland. *Id.* at 41. In general, state reports to the EPA list agricultural runoff as the most prevalent source of water quality problems. U.S. EPA, Office of Water, The Quality of Our Nation's Waters 64, 87, 107 (2000).

vineyards at issue here would not be replanted every year, but vintners typically keep soil uncovered between the plants.

Third, cropland typically involves heavy inputs of fertilizer and pesticides, while such uses on rangeland are far smaller or non-existent.[27] The runoff of these chemicals creates significant water quality problems.

Finally, rangeland typically maintains far greater habitat values for the grassland species that used them.[28] Indeed, some grazing is critical for many species that depend on grazing lands. The conversion of grasslands to crops is considered a major cause of concern for much wildlife.[29]

All human uses of the land can have some adverse environmental effects, and excessive or inappropriate grazing can do so as well. However, science bears out Justice O'Connor's statement that "good grazing practices could be good for the land." O'Connor & Day, supra, at 262-63.

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27 Geography of Hope at 43, 46 (maps of national potential runoff of nitrogen, phosphate and pesticides show high cropping areas as areas of concern and rangelands as of little concern). While more than 600 million pounds of active pesticide ingredients were applied to corn, wheat, soybeans, cotton, vegetables, potatoes and fruit, so few pesticides are applied to rangeland that USDA does not survey uses on rangeland. See Economic Research Service, *supra* note 21, chapter 4.3

28 As one summary states: "A convincing argument can be made that grazing is necessary for a healthy grassland ecosystem. Light to moderate grazing stimulates grass growth, disturbs the seedbed, and returns nutrients to the soil through excreta. In fact the variety of life in the great grasslands of North America was shaped in large part by grazing." D.S. Licht, Ecology & Economics of the Great Plains 67 (1997).

29 "In recent decades, many farmers have converted their hayfields and pasturelands to the more profitable row crops, a change that has decimated populations of some [grassland] birds." Wilcove, *supra* note 11, at 98 (summarizing grassland bird declines).

Treating the conversion from a grazed wetland to an upland crop as a change in use is consistent with common usage, sound science and obvious environmental differences.

E. Section 404(f) has robust affects without Petitioner's expansive reading.

Applying Section 404(f) to regulate conversion of wetlands to uplands used for crops does not deprive the "normal farming" exemption in 404(f)(1) of major significance. Of the remaining wetlands in the United States, roughly 10.5 million acres are estimated to be so-called "cropped wetlands" by the U.S. Department of Agriculture.[30] These are wetlands that remain inundated in the late winter or spring, but in which the water runs off early enough to allow farmers to plow and grow crops at least in some years. Some of these wetlands have been subject to some drainage but not enough to eliminate wetland conditions; others are not drained at all. The functions of these wetlands are degraded, but they can still be valuable in many cases. Depending on

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30 Heimlich et al at 22; *see also* National Research Council, National Academy of Sciences, Wetlands: Characteristics and Boundaries 158 (1995) (10 million acres of farmed wetlands). For identifying which cropped wetlands are still flooded enough to be considered wetlands, the EPA and Corps of Engineers use the same standards used by the U.S. Department of Agriculture. *See* U.S. Soil Conservation Service, U.S. Environmental Protection Agency, U.S. Army Corps of Engineers, U.S. Fish & Wildlife Service, Memorandum of Agreement Concerning Wetlands Determinations for Purposes of Section 404 of the Clean Water Act and Subtitle B of the Food Security Act (1994) (stating that "agricultural lands" which are defined not to include rangelands, shall be identified using USDA standards). USDA's standards are set forth at 7 C.F.R. Section 12.31 and 12.32(a)(3) and provide that a wetland is not considered fully converted, even if converted for cropping, if "surface water is present for extended periods especially early in the growing season even though it may be absent by the end of the season in most years."

the circumstances, they can still store and hold floodwaters, filter sediments and other pollutants, provide spawning areas for fish, and feeding grounds for water birds.[31]

Section 404(f) guaranties that farmers can, without a permit, continue to plow, maintain drainage systems and engage in any other normal activity used to grow crops. They may similarly switch to other crops. Section 404(f) similarly guaranties that foresters can continue to build roads and harvest timber without a permit. Section 404(f) therefore has significant effects without Petitioners' overly expansive reading.

II. Relocations of sediments and soils dredged from beneath the surface in wetlands, streams and bays add and therefore discharge pollutants.

Borden Ranch Partnership's activities in this case involved dredging materials from five to seven feet down from the bottom of the wetland, and pushing it in a manner that in some cases "mounded" the material and in other cases created raised rows at least two feet high. District Court Opinion, E.R.1028-30. The District Court found that these soil movements "filled" drainages hundreds of feet long either "partially" or "fully," ER 1028-30, and that pollutants moved "horizontally and vertically." E.R. 1012. Petitioners characterize their activities as simply "turn[ing] soil in place," Brief of Petitioners at 18, but this description ignores the environmental significance of the relocation, which

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31 National Research Council, *supra* note 30, at 160-61 (stating that "[a]gricultural wetlands" although reduced in function "are generally found in an extensively altered landscape where they can be particularly important for controlling water quality, preventing floods, and maintaining biodiversity" and describing particular values in filtering agricultrural runoff).

exposed soil immediately at or near the surface that previously had only been buried several feet.

Petitioners claim that these movements do not make an "addition" of "any pollutant" to the water body and therefore cannot constitute "discharges" under Section 502(12). Petitioners do not appear to dispute the many lower court cases that have found pushing soil around in a wetland to be discharges. Brief of Petitioners at 26-27. Close inspection of these cases reveals that they address activities hard to distinguish from this case, ranging from cutting vegetation and pushing it into wetlands to the construction of drainage ditches by pushing material to the side of the ditch. Petitioners' wish to distinguish the soil-moving activities at issue in this case in part on the theory that anything that can be described as plowing cannot be a discharge, and in part on a theory that the relocations are somehow too minor to add pollutants. Both distinctions are unfounded.

A. *Chemical and biological significance of this relocation.*

In *United States v. Deaton*, 209 F.3d 331 (4th Cir. 2000), the United States Court of Appeals for the Fourth Circuit explained well why even relatively small-scale excavation and relocation of materials from beneath the surface of a wetland or stream adds pollutants: It may not add material, but it adds a pollutant, "dredge material" that did not exist when materials were present only in a more benign form:

> "Contrary to what the Deatons suggest, the statute does not prohibit the addition of material; it prohibits 'the addition of any pollutant.' The idea that there could be an addition of a pollutant without an addition of material seems to us entirely unremarkable. . . . It is of no consequence that what is

> now dredged spoil was previoussly present on the same property in the less threatening form of dirt and vegetation in an undisturbed state."'

209 F.3d at 335.

Moreover, the Deaton court did a good job of explaining the scientific basis for concern with material dredged from wetlands, particularly when associated with drainage.

> "Wetlands perform a vital role in maintaining water quality by trapping sediment and toxic and nontoxic pollutants before they reach streams, rivers, or other open bodies of water. See Office of Technology Assessment, U.S. Congress, Wetlands: Their Use and Regulation 48-50 (1984). Given sufficient time, many (but not all) of these pollutants will decompose, degrade, or be absorbed by wetland vegetation. See *id.* at 48-49. When a wetland is dredged, however, and the dredged spoil is redeposited in the water or wetland, pollutants that had been trapped may be suddenly released. See *id.* at 49 ("Natural or man-made alterations of the wetland caused by lowering the water table, dredging, and the like, could mobilize large quantities of toxic materials."); *id.* at 124 ("A long-term effect of the disposal of contaminated dredged spoil in or near wetlands is the potential bioavailability of toxic chemicals such as oil and grease, pesticides, arsenic, and heavy metals, when the sediments are resuspended periodically."). At the same time, the increased drainage brought about by the dredging may render the surrounding wetland unable to reabsorb and filter those pollutants and sediment (the very purpose of dredging is to destroy wetland characteristics). See 400 C.F.R. § 230.41(b) (explaining how discharge of dredged or fill material

> in wetlands "can degrade water quality . . . by interfering with the filtration function of wetlands . . . "). Even in a pristine wetland or body of water, the discharge of dredged spoil, rock, sand, and biological materials threatens to increase the amount of suspended sediment, harming aquatic life. See *id.*; Office of Technology Assessment, supra, at 48."

209 F.3d at 336 (some citations deleted, elipsis added).

The basic scientific fact recognized by the court in *Deaton* is that sediments and their associated pollutants buried even a few feet beneath the surface of a bay, river or wetland are far less biologically available than those same sediments and pollutants when spread across the surface. In a recent rule-making on the activities that cause discharges, many of the amici scientists submitted comments identifying dozens of scientific references that show the significance of this change.[32] These comments were extensively summarized in the preamble to the final report and found to be credible by the EPA and the Army Corps of Engineers. Environmental Protection Agency, Department of Defense, "Further Revisions to the Clean Water Act Regulatory Definition of 'Discharge of Dredge Material,'" 66 Fed. Reg. 4550, 4563-64 (July 13, 2001). The discussion below is largely drawn from these comments.

The upper foot or even smaller portion of a wetland or stream or river bottom is of great ecological significance.[33]

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[32] Letter to Mike Smith & John Lishman from Dr. Joy Zedler et al. (October 16, 2000).

[33] See generally Josephine Y. Aller, Sarah A. Woodin, and Robert Allert (eds.), Organism –Sediment Interactions: Proceedings of the 1998 Organism-Sediment Interactions Symposium (1998) (discussing importance of upper sediment layer for biochemical interactions between sediments and water column and use by marine animals). As the leading textbook on wetlands states, "Wetland soil is both the medium in which

Large numbers of aquatic organisms from worms to shellfish live in this surface layer, in which many fish also lay their eggs. The sediment characteristics required for these organisms may be precise. (As one well known example, salmon eggs require gravel beds.) A major concern with the redeposit of dredge material is that when new sediments replace the old, they may bury these organisms, or they may no longer be compatible with the needs of the organisms.[34]

Increased loads of chemical pollutants attached to the sediment below the wetland are also a concern because bottom dwelling organisms tend to absorb chemicals, such as metals, and may pass them up the food chain to fish and ultimately humans in increasingly concentrated form.[35] And redeposited material and its chemical pollutants are also typically left in less compact form than normal wetland soils or sediments, and therefore are more easily swept up into the water column or down a stream or drainage ditch where they may cause other harm. Studies have repeatedly found

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many of the wetland chemical transformations take place and the primary storage of available chemicals for most wetland plants." William. J. Mitsch & James G. Gosselink, Wetlands 115 (1993). In general, the particular characteristics of wetland soils, particularly those in the upper foot, determine the ways in which they take up, transform the form of and release nutrients, including phosphorus and nitrogen, with significant effects on adjacent and downstream waters. *Id.* at 139-42,152-58.

34 The scientist submittal discusses numerous studies finding impacts of sediment from dredge material on mussel populations. It also discusses the sensitivity of salmon and trout species to sedimentation of their nests, called "redds."

35 One study that followed the chain of toxicity effects up the food chain following disturbance of sediments, in that case by a major flood, is J.P. Ludwig, *Caspian Tern Reproduction in Saginaw Bay Ecosystem Following a 100-year Flood Event*, 19 J. Great Lakes Research 96-108 (1993).

increased levels of runoff of suspended sediment during and after excavation of drainage projects.[36]

In addition, there tends to be continuous interchange between the chemical constituents in the water column and those either attached to the sediments in the upper layer or in the water between the sediments.[37] These are active areas, for example, in which pollutants may be transformed, removed or released into the water column.[38] Changes in the composition of soil and sediment by the redeposit of material can alter these important interactions.

As the *Deaton* court explained, wetland soil movements associated with drainage activity cause particular concerns because the drainage reverses many of the chemical processes that allow wetlands to bind up or break-down

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36 T.A. Ivari, *Effect of Choptank Watershed Drainage Project on Suspended Sediment Concentration, in* Proceedings of the 1991 National Conference Sponsored by the Irrigation and Drainage Division of the American Society of Civil Engineers and the Hawaii Section 223-230, 230 (1991); C.E. Simmons and S.A. Watkins, The Effects of Channel Excavation on Water Quality Characteristics of the Black River and Ground-water Levels Near Dunn North Carolina, US. Geological Survey Water Resources Investigations (1982).

37 For this reason, studies of the Everglades pollution problem described below include careful analysis of the factors that affect how soil and water concentrations of phosphorus affect each other. See Jose A. Amador, G. Hafiza Richany and Ronald D. Jones, *Factors Affecting Phosphate Update by Peat Soils of the Florida Everglades*, 153 Soil Science 46370 (1992); Jose A. Amador & Ronald D. Jones, *Nutrient Limitations on Microbial Respiration in Peat Soils with Different Total Phosphorus Content*, 25 Soil Biol. Biochem. 793 801 (1993).

38 In mined streams and lakes below them, studies in New Zealand, Australia have shown both increased turbidity, that blocks light to bottom dwelling plants, and heavy toxic releases from the mined sediments. P.A. Ryan, *Environmental Effects of Sediment on New Zealand Streams: A Review*, 25 New Zealand J. Marine and Freshwater Research 207-221 (1991).

pollutants. Wetlands have this capacity in part because their top soil layer tends to lose its oxygen (become anaerobic) when flooded or saturated, and biochemical interactions in the absence of oxygen include the binding of many toxic materials and the breakdown and release of nitrate into harmless forms. The drainage restores the oxygen to the soils and leads to the release of pollutants, including both toxic metals and nutrients.[39]

The potential impacts are significant. According to the Environmental Protection Agency "[a]pproximately 10% of the sediment underlying U.S. surface waters is sufficiently contaminated with toxic materials to pose potential risks to fish and to humans and wildlife that eat fish."[40] Reflecting these kinds of risks, the Senate Report to the Clean Water Act amendments of 1977 explains that one of the goals of the permit program was to control "the contamination of water resources with dredged or fill material that contains toxic substances." S. Rept. No. 95-370 at 74, *reprinted in* 1977 U.S.C.C.A.N. at 4399.

The Everglades provides an acute illustration of how dredging activities that drain wetlands can lead to water

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39 See R.P. Gambrell, *Trace and Toxic Metals in Wetlands, A Review* 23 J. Env'l Qual. 883-91 (1994)(summarizing studies showing the release of toxics when canals are constructed through wetlands and the removed material is placed to the side of the constructed channel as spoil); John W. Portnoy, *Salt Marsh Diking and Restoration: Biogeochemical Implications of Altered Wetland Hydrology*, 24 Env'l Management 111-20 (1999) (experimental study showing that rewatering of diked and drained salt marshes can release large concentrations of nutrients); W. Peterson, E. Wiler & C. Williamowski, *Remobilization of Trace Elements from Polluted Anoxic Sediments After Resuspension in Oxic Water*, 99 Water, Air and Soil Pollution 515-22 (1997) (discussing release of toxics from newly exposed sediments).

40 U.S. Environmental Protection Agency, Summary Fact Sheet: Contaminated Sediment, EPA's Report to Congress 2 (January 1998).

quality problems. Phosphorus running off sugarcane fields through drainage ditches carved out of wetlands is transforming the historic "river of grass" into dense stands of cattail with limited oxygen and limited aquatic life.[41] Most of this phosphorus is believed to originate in phosphorus once bound and long stored in those wetland soils but released because of the effects of drainage.[42] The plan being implemented to fix this problem has an estimated cost to agriculture and taxpayers of roughly $700 million. Yet, this phosphorus, like many pollutants, causes problems in miniscule amounts, measured in parts per billion. The fact that significant water pollution can often be based on such miniscule 'additions" makes it particularly inappropriate for this Court to require any kind of "volume" or distance test before an addition of a pollutant can be treated as an addition.

B. Congress's desire to regulate even "incidental" discharges associated with the drainage of wetlands counsels against a limitation of regulation to large soil movements.

Petitioners ask this Court to distinguish the activities in this case from what it views as the more "major" relocations of wetland soils at issue in many other lower court cases. (Brief of Petitioners at 26-27 & n. 17). But apart from the fact that significant pollution can occur in tiny concentrations and Borden Ranch's activities were "major" enough to "fill"

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41 Doren, R.F., T.V. Armentano, L.D. Whiteaker and R.D. Jones, *Marsh Vegetation Patterns and Soil Phosphorus Gradients in the Everglades Ecosystem*, 56 Aquat. Bot.145-163 (1997).

42 U.S. Army Corps of Engineers, Florida's Everglades Program Everglades Construction Project Environmental Impact Statement 2-3 (1995) (drainage of wetland soils in agricultural area leads to the formation of soluble phosphorus that drains into network of canals and pumping facilities and is pumped into Everglades); *id.* at 3-49 (estimated cost of clean-up project is $674 million).

multiple swales 700, 800 and 1000 feet long, ER 1028-29, any distinction based, in essence, on the magnitude of the addition of dredge material would be inconsistent with Section 404(f)(2).

Section 404(f)(2) requires that even "incidental" discharges be regulated if they are associated with "any" activity that changes the use and reduces the reach of waters, including wetlands. The term "incidental" means "subordinate, nonessential, or attendant in position or significance as a: occurring merely by chance or without intention or calculation, [or]. b: being likely to ensue as a chance or minor consequences . . . ." Webster's Third New International Dictionary (unabridged) (1981). The choice of the term "incidental" means that a discharge need be neither intentional nor large.

Section 404(f)(2) also does not require that the ecological affect of the discharge be big enough to cause harm: The language Congress selected focuses on whether the broader activity, to which the discharge is "incidental," reduces the reach or impairs the flow of a regulated wetland or other water body. As previously discussed, Congress was aware that this is achieved typically through drainage, which can be achieved in a variety of ways, including deep-ripping for some wetlands. This focus too indicates that an addition of a pollutant during drainage of swamps should not be disregarded even if the addition itself were minor.

Finally, Section 404(f)(2) applies to a discharge incidental to "any" activity that involves a change in land use and alteration of wetland hydrology. Because Petitioners believe that Congress intended to exempt all agricultural activities, they believe that drainage accomplished through activities that look like plowing cannot be recaptured. But the fact that Section 404(f)(2) applies to "any" activity with

the requisite effects -- whether plowing like or even plowing itself – contradicts Petitioners' argument.

To be sure, normal plowing does not have the effect of draining wetlands and so will not be recaptured. But as the District Court found, deep ripping does.

Petitioners rely heavily on *National Mining Association v. U.S. Army Corps of Engineers*, 145 F.3d 1399 (D.C. Cir. 1998) ("NMA"),which held that the agencies could not regulate something the court referred to as "incidental fallback." The court believed such fallback occurs when materials fall back to the "same spot" as a result of a specific technique for constructing drainage ditches used by some developers. *Id.* at 1401. NMA is not applicable because the relocations at issue in this case are far more extensive than the "incidental fallback" described in NMA. However, the analysis here does support the view that NMA was wrongly decided. For reasons discussed above, the excavation of a drainage ditch in a wetland will almost certainly involve an addition of sediment and associated pollutants previously buried under the wetland, and many of these pollutants are likely to eventually move down the drainage ditch. Moreover, the "incidental" nature of the discharge did not appear to matter to Congress, which wanted to regulate discharges "incidental" to activities that drain wetlands. While this Court need not reach the merits of NMA in this decision, that decision was not based on a sound scientific understanding of how pollutants are added during excavation activities in wetlands.

C. Congress did not exclude "plowing" from the definition of a discharge.

Much of Petitioners brief seems premised on the assumption that Congress exempted "plowing" in all cases from the definition of the term "discharge," so the claim that

their activities can be analogized to plowing should dispose of the case. This contention has no textual support. Instead of amending the word "discharge" in 1977, Congress only decided to exempt "plowing" conditionally from a permit requirement if not recaptured under Section 404(f)(2). If any activity that could be analogized to plowing could never be a discharge, there was no reason to exempt it and no reason to subject the exemption to recapture. The common sense implication is that even plowing can be a discharge in some cases. And by choosing the approach it did, Congress was able to draw the line between exempt plowing and regulated activities at the point at which soil relocation converts wetlands.[43]

D. The broad definition of "pollution" supports a broad reading of the term discharge.

It seems reasonable that the determination of whether an activity "adds" a pollutant should be influenced by whether it is deemed likely or capable of causing "pollution." 33 U.S.C. Sec. 1362(19). The Clean Water Act defines "pollution" as "the man-made or man-induced alteration of the chemical, physical, biological, and radiological integrity of water." As this Court explained in *United States v. Riverside Bayview Homes, Inc.*, 474 U.S. 121, 132 ((1985), "'the word 'integrity' . . . refers to a condition in which the natural structure and function of ecosystems is [are] maintained.'" (quoting House Report; ellipsis and insertions in original). For the reasons discussed above, activities that

[43] See also *Minnehaha Creek Watershed District v. Hoffman*, 597 F.2d 617, 626 (8th Cir. 1979): "[I]t is obvious that an exemption . . . would be necessary only if such work is generally subject to Sec. 404 permitting requirements." *See generally Ratzlaf v. U.S.*, 510 U.S. 140 (1994) ("judges should hesitate so to treat statutory terms" as "words of no consequences,"), *Washington Market Co. v. Hoffman*, 101 U.S. 112, 115 (1879) (It is a "cardinal rule of statutory construction that significance and effect shall, if possible, be accorded to every word.").

relocate material from beneath the surface of a wetland to the surface, and activities that convert wetlands, do not preserve this integrity of aquatic ecosystems.

CONCLUSION

For the foregoing reasons, Petitioners' activities were properly regulated under the Clean Water Act.

Respectfully submitted,

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October 25, 2002

Appendix A – Brief Biographies of Amici

Dr. Joy Zedler is Aldo Leopold Chair of Restoration Ecology at the University of Wisconsin and a former member of the National Academy of Science's Water Science and Technology Board. She recently chaired a panel of the National Academy of Sciences National Research council studying wetland mitigation and previously served on panels that analyzed wetland identification and classification and restoration of aquatic ecosystems.

Dr. Gene Likens is President and Director of the Institute for Ecosystem Studies, Vice President of the New York Botanical Garden, Director of the Mary Flagler Arboretum and Professor of Biology at Yale University. A member of the National Academy of Sciences and Past President of the Ecological Society of America, he has been awarded nine honorary degrees from Universities around the world among numerous international professional awards. His more than 400 articles and 14 books explore a wide range of ecological fields with a particular emphasis on biogeochemistry. This year, Dr. Likens also won the National Medal of Science, the nation's highest science award.

Dr. Ronald Jones is Professor of Biology and Director of the Southeast Environmental Research Program at Florida International University. A specialist in the biochemistry of wetland soils, he has published more than 40 peer-reviewed articles, many related to the impact of phosphorus on the Everglades and its relationship to soil interactions. Dr. Jones has been the lead researcher on separate projects related to the protection and restoration of the Everglades funded by Everglades National Park, the U.S. Army Corps of Engineers, the Environmental Protection Agency and the South Florida Water Management District.

Dr. Orie Loucks is Ohio Eminent Scholar in Applied Ecosystem Studies and Professor of Zoology at Miami University of Ohio. The author of more than 200 scientific publications, he served ten years on the National Academy of Science's Board on Water Science and Technology and also on the Science Advisory Board of the International Joint Commission, and the Board of Governors of The Nature Conservancy. He is an elected Fellow of the Ohio Academy of Sciences and the American Association for the Advancement of Science, and was given the Distinguished Service Award of the American Institute for Biological Sciences in 1994.

Dr. Rebecca R. Sharitz is a Professor of Botany at the University of Georgia and a Senior Research Ecologist at the Savannah River Ecology Laboratory, where she previously served as director. She has served as Secretary General of the International Association of Ecology and on the National Academy of Science Committee for the Restoration Aquatic Ecosystem and Restoration of the Greater Everglades System.

Dr. Raymond Semlitsch is professor of Biology at the University of Missouri. One of this country's leading experts on amphibians, he has published more than 100 articles, including many of the leading papers on the use of isolated wetlands by amphibians.

Dr. Leigh H. Fredrickson is Rucker Professor of Fisheries and Wildlife at the University of Missouri and Director of the Gaylord Memorial Laboratory. He has published more than 100 articles, primarily on waterfowl, water birds and wetlands.

Dr. Barbara Bedford is Senior Research Associate in the Department of Natural Resources at Cornell University, and former director of the Ecosystems Research Center of

Excellence. She has published many articles on the interactions between wetland plant communities, hydrology and nutrient loading, and has been a member of a peer review panel established to advise the Florida agencies on the clean-up of the Everglades.

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